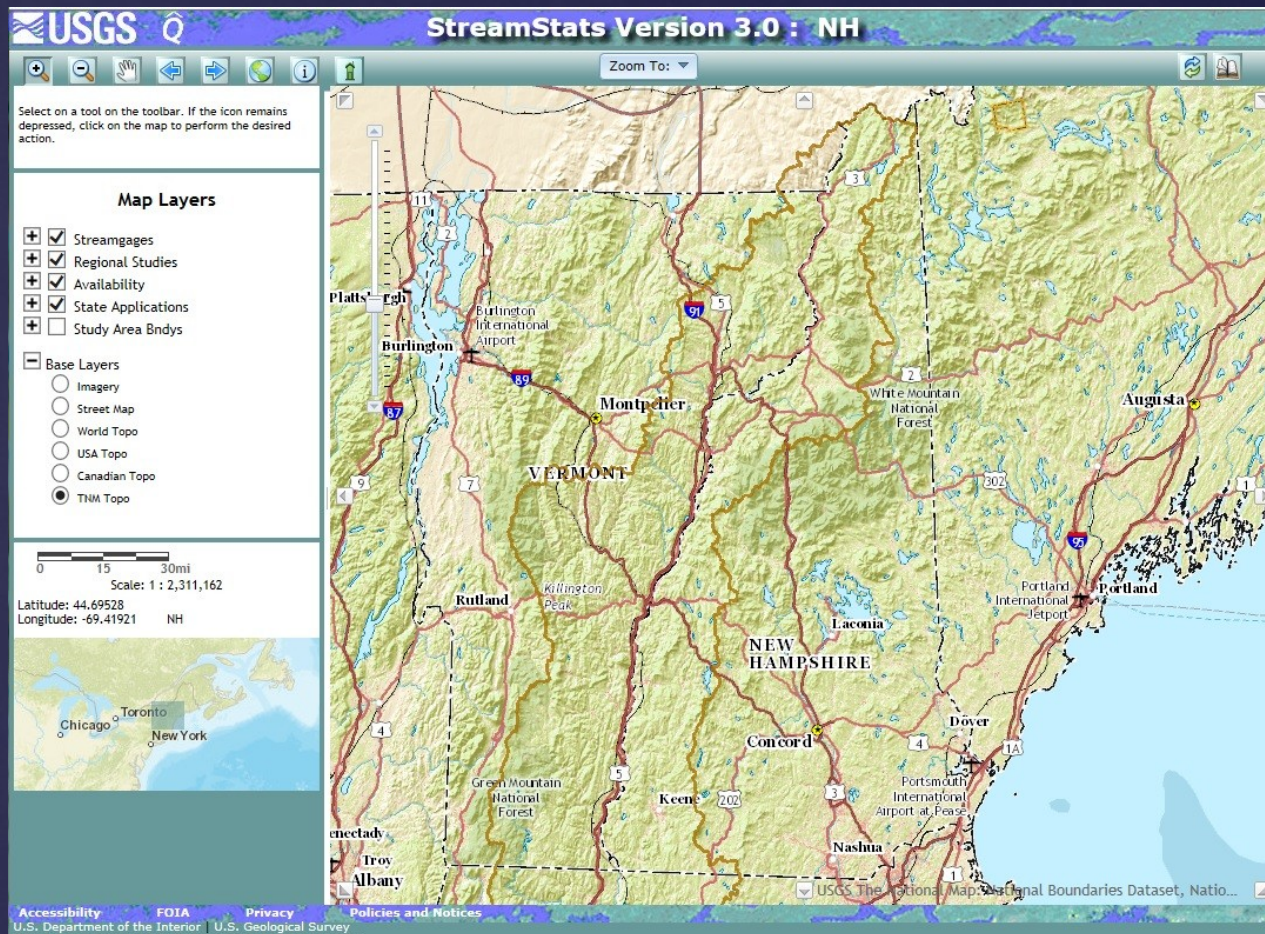


New Hampshire StreamStats

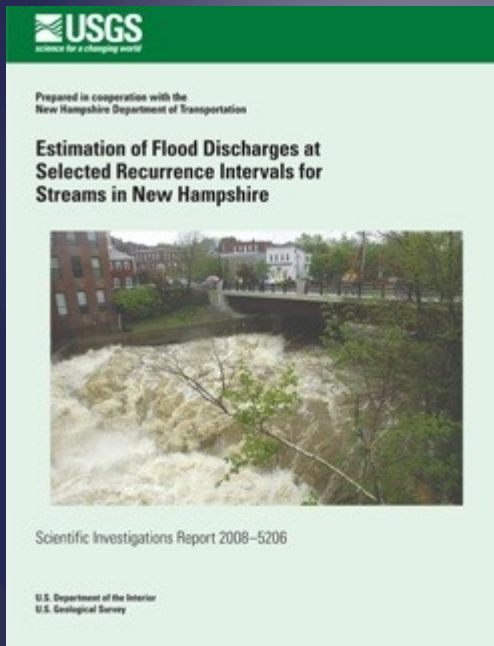


<http://streamstats.usgs.gov>

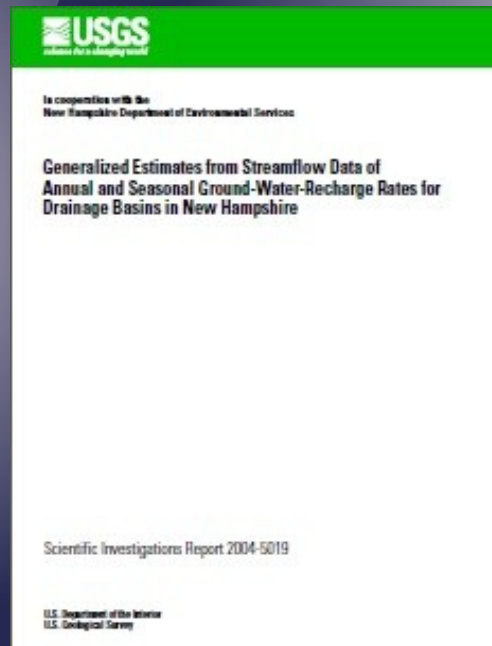
Robert Flynn, P.E. - USGS
May 11, 2016

StreamStats

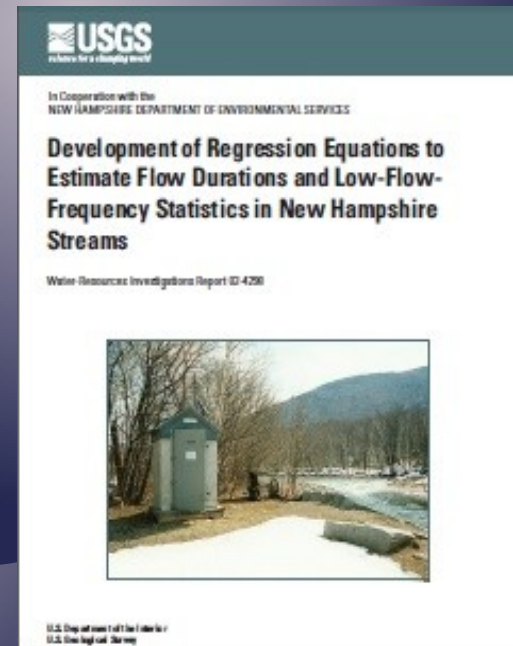
GIS-based Web application for calculating basin characteristics and streamflow and ground-water-recharge-rate statistics for user-selected sites on streams



Peak Flows
(Olson, 2009)



Seasonal and Annual
Ground-Water-Recharge Rates
(Flynn and Tasker, 2004)



Seasonal and Annual
Low-Flow and Flow Duration
(Flynn, 2003)

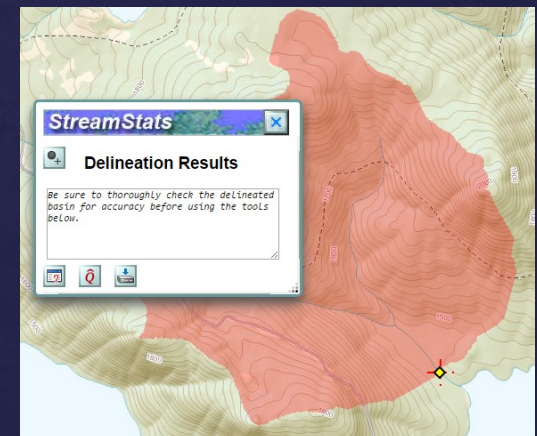
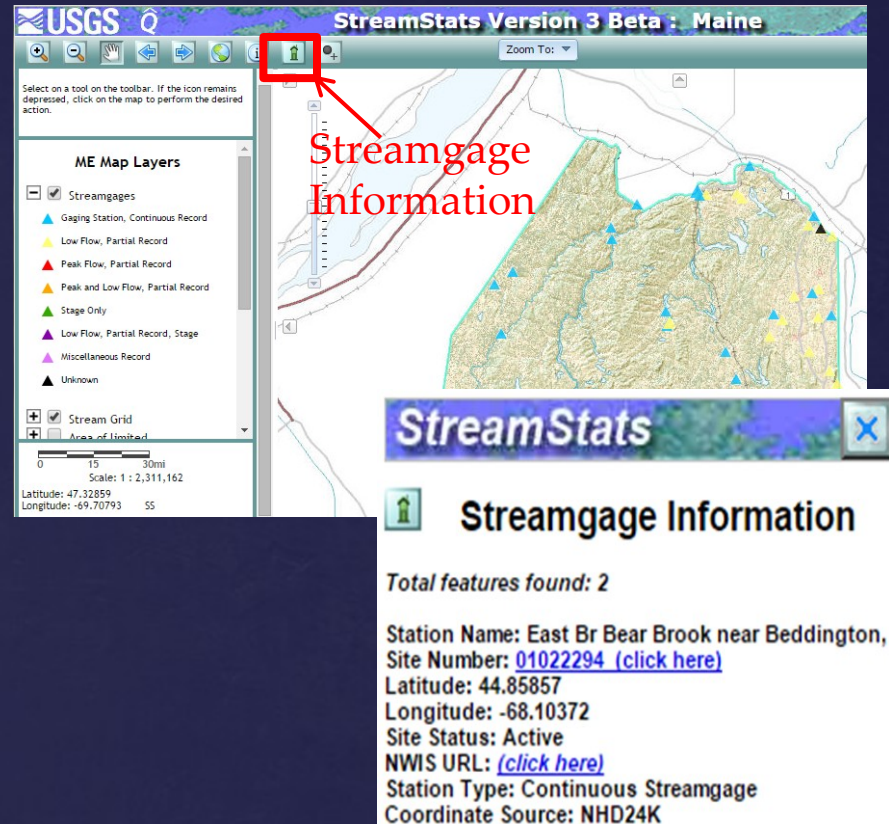
NH Streamstats

- Incorporates regression equations that can be used to estimate the long-term flood discharges at recurrence intervals of 2-, 5-, 10-, 25-, 50-, 100-, and 500-years.
- In addition, regression equations provide estimates of the seasonal (spring, summer, fall, and winter) and annual 7-day 2-year (7Q2) and 7-day 10-year (7Q10) low-flow frequency values, as well as seasonal period-of record and period-of-record flow durations (60-, 70-, 80-, 90-, 95-, and 98-percent exceedences).
- NH regression equations are applicable for ungaged reaches of unregulated New Hampshire streams.
- USGS reports present the equations used to estimate the flow statistics, describe the errors associated with the estimates, and describe the methods used to develop the equations and to measure the basin characteristics used in the equations.

- Olson, S.A., 2009, Estimation of flood discharges at selected recurrence intervals for streams in New Hampshire, U.S. Geological Survey Scientific Investigations Report 2008-5206, 57 p.
- Flynn, R.H. and Tasker, G.D., 2004, Generalized Estimates from Streamflow Data of Annual and Seasonal Ground-Water-Recharge Rates for Drainage Basins in New Hampshire: U.S. Geological Survey Scientific Investigations Report 2004-5019, 61 p.
- Flynn, Robert H., 2003, Development of regression equations to estimate flow durations and low-flow-frequency statistics in New Hampshire streams, U.S. Geological Survey Water-Resources Investigations Report 02-4298, 66 p.

StreamStats

- Provides published basin characteristics and streamflow statistics at gaged locations
- Calculates basin characteristics and streamflow statistics at ungaged locations
 - Delineates watershed
 - Generates flows using regression equations



NH Streamflow Statistics

(examples)

- 1% Annual Exceedance Probability (100-year) flood
- Average annual & seasonal ground-water-recharge rates
- 7-day, 10-year low flow (7Q10) (annual and seasonal)
- 90-percent duration flow (annual and seasonal)



Regression Equations

- Developed statistically
- Always includes Drainage Area (A)
- Often another variable
 - Precipitation
 - Wetlands
 - Slope
 - Temperature
 - Geology
 - Location

Example Regression Equations

- Peak Flow:

$$Q_{100} = 5.96A^{.879}P^{1.94}10^{(-0.0252*Wetland)}S^{0.203}$$

- Low-Flow Frequency:

$$7Q_{10} = 1.27688*10^{(5.33462)*}A^{1.39481} * ABT^{-7.67405} \\ *SGP^{4.16826}$$

- Ground-Water-Recharge:

$$\text{Annual} = -1.932 + 0.589(P) - 0.176(C)$$

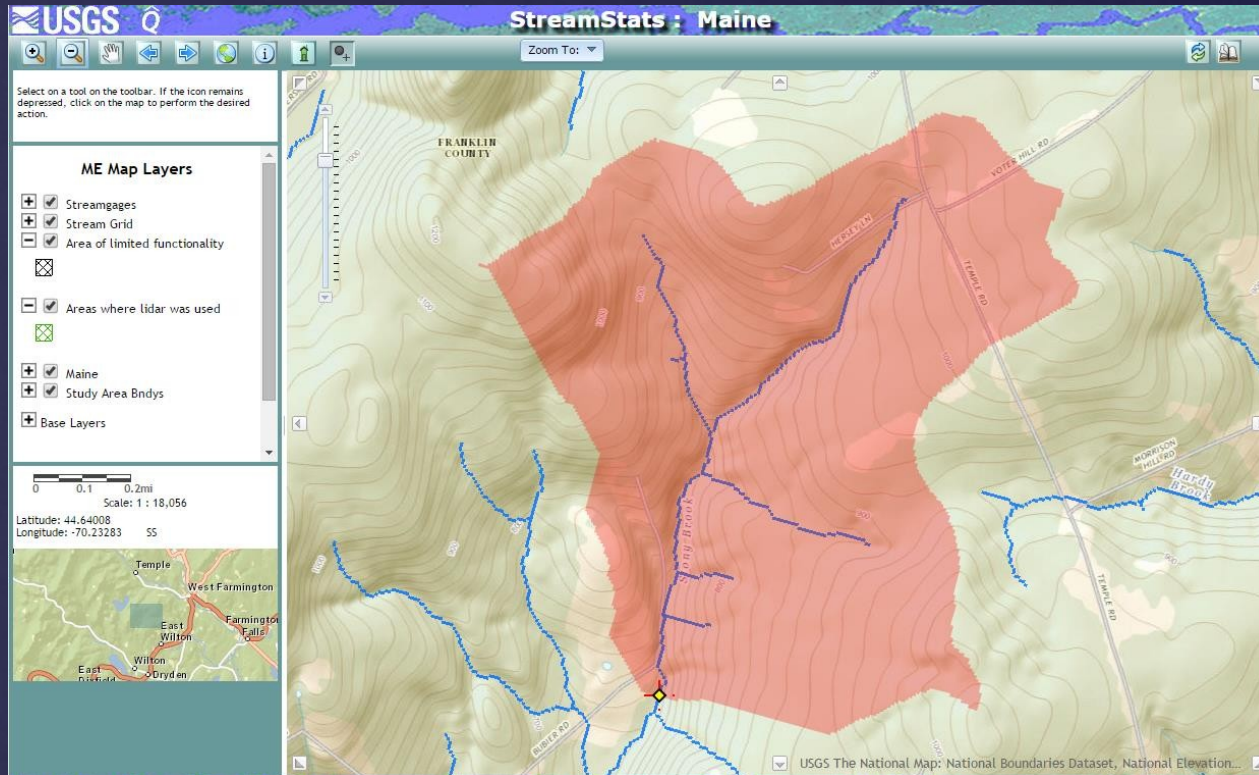
NH Basin Characteristics (examples)

- Drainage Area
- Slope
- Mean Annual Precipitation (NRCS PRISM data)
- Mean Annual Temperature
- Basin Percent wetlands
- Basin percent impervious area
- Basin Percent forested
- Maximum basin Elevation
- Mean annual snowfall

StreamStats Benefits

- Accuracy
- Accessibility- user does not need a GIS
- Speed
- *Consistent Results*
 - Repeatable
 - Dependable

StreamStats Data

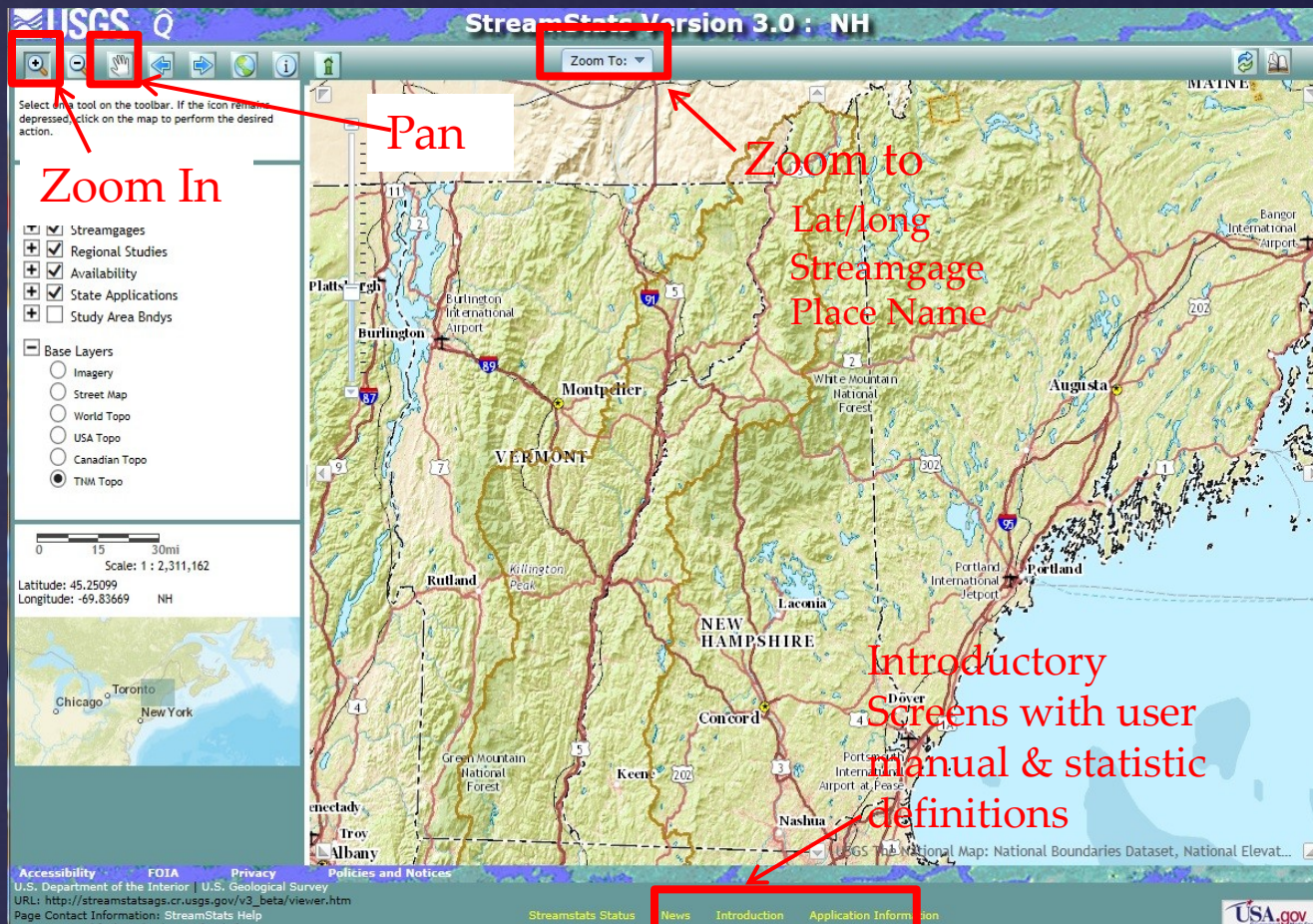


Delineates basins based on:

- 24K NHD
- 24K WBD
- 10M DEM or lidar

DEMONSTRATION

<http://streamstats.usgs.gov>

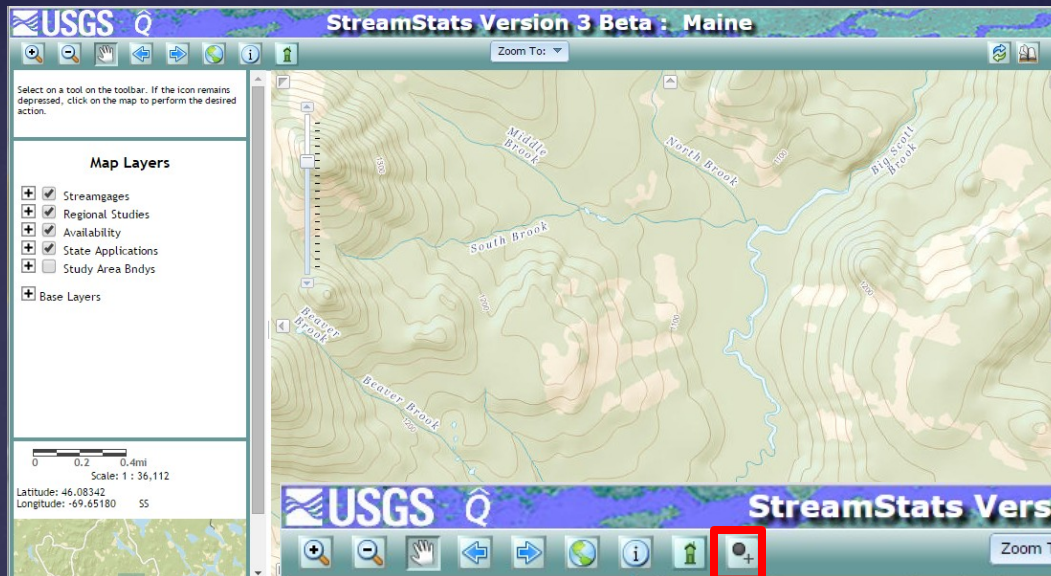


http://streamstatsags.cr.usgs.gov/v3_beta/viewer.htm?stabbr=NH

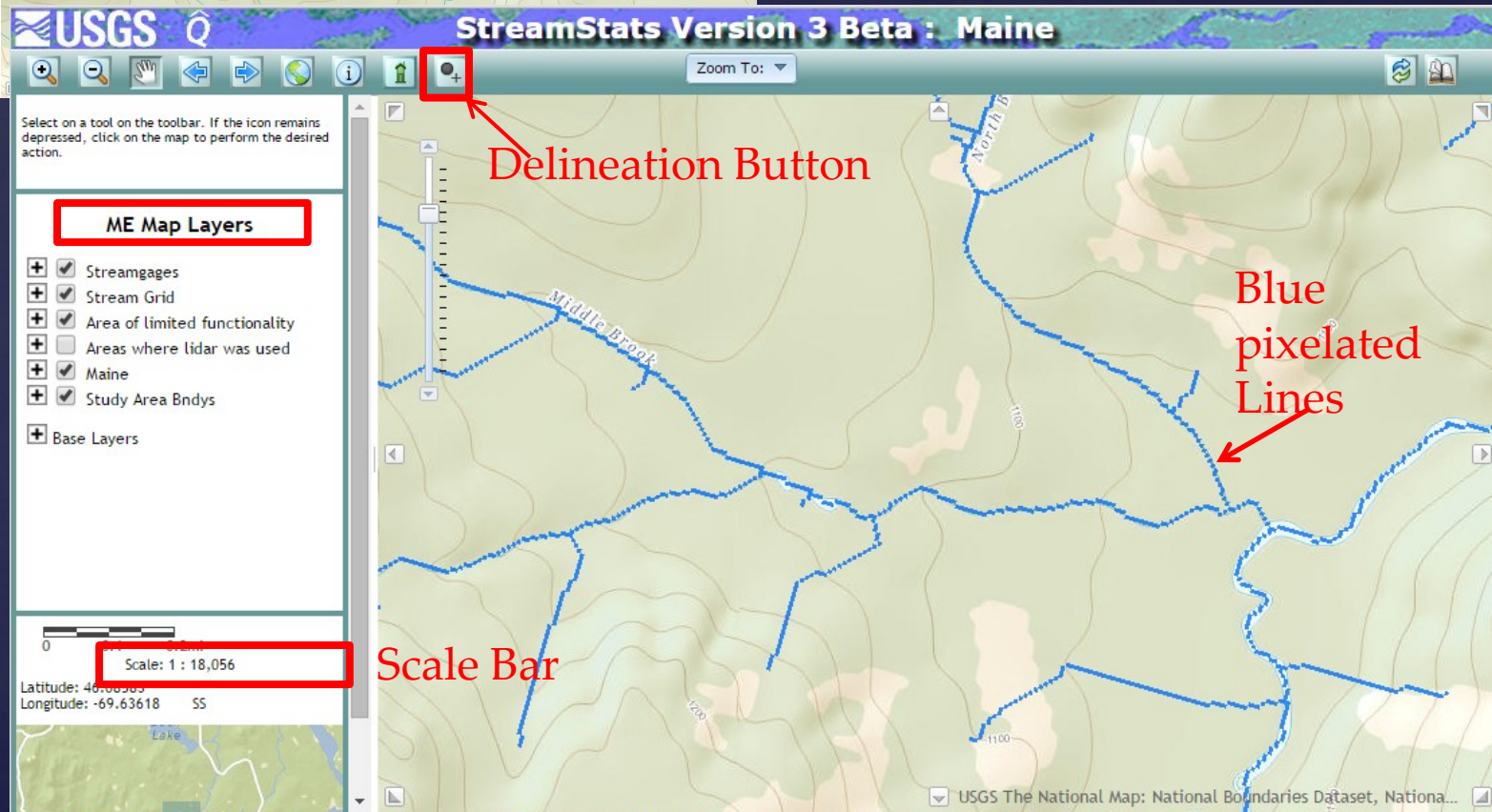
- This link may change over time
- Click yellow text at bottom to get to documentation/ instructions

CANNOT delineate a basin

Scale < 1:24,000



CAN delineate a basin
Scale > 1:24,000





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Transition to Version 3 -- Pardon our Dust!

StreamStats is in the process of transitioning from version 2 to version 3 as quickly as possible. Version 2 provides a separate user interface for each individual state, whereas version 3 provides a single national user interface through which to access the functionality that is available for each state. There are some minor differences in the appearance and operation of the version 3 user interface, a beta version of which is now available for some states. In particular, version 3 adds several new options for quickly locating (zooming into) sites of interest.

Currently, not all of the functionality that is available in version 2 can be made available in beta version 3. As a result, the transition to version 3 is being staged in the following manner:

New states.— All newly implemented states will be released in beta version 3 with whatever functionality is available at the time. As a minimum, users will be able to get information for USGS data-collection stations and basin delineations, basin characteristics, and estimates of streamflow statistics from regression equations for user-selected unengaged sites.

Previously implemented states with new equations for estimating streamflow statistics.— These states will be released in beta version 3 with the new equations and whatever other functionality is available at the time. The previously implemented states will continue to be available in version 2 and the beta version 3 version 3 on.

Previously implemented states with no new functionality.— These states will remain at version 2 until all version 2 functionality is available in version 3.

All states that have been made available in beta version 3 will have a page for the state. Although the results provided by the beta version 3 are assured, users may experience some user interface performance issues.

StreamStats is a Web application that incorporates a Geographic Information System (GIS) access to an assortment of analytical tools that are useful for a variety of management purposes, and for engineering and design purposes. Users can view collection station locations shown on a map and obtain previously available data. Users can also select any location along a stream and obtain the drainage area, stream length, and stream order for that location.



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Version 3 Streamflow statistic definitions

StreamStats

Statistics Definitions

Welcome to StreamStats

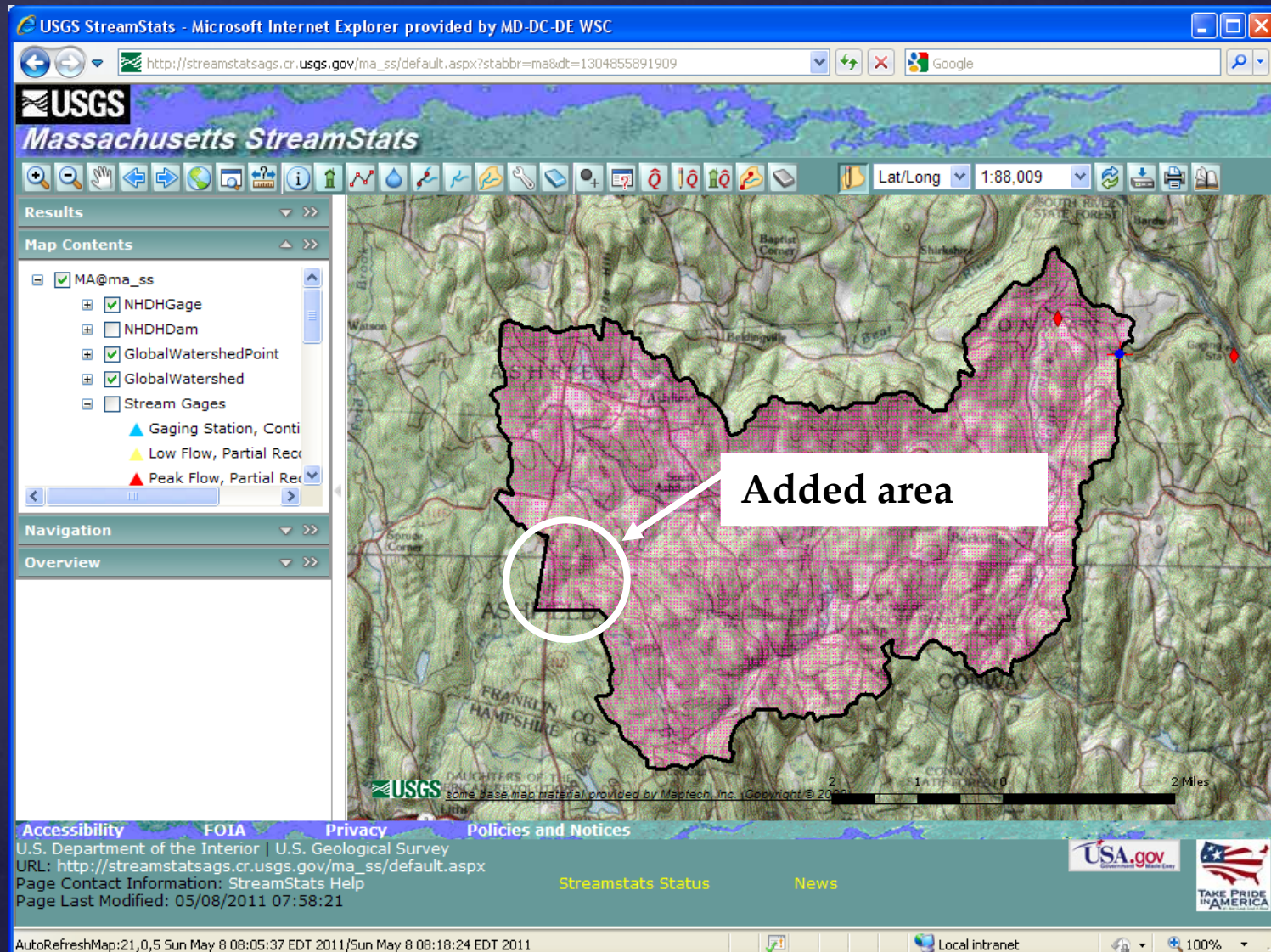
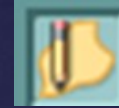
Streamflow Statistics Definitions

The StatLabel, as shown in the first column of the table below is given as the statistic name in the StreamStats output for unengaged sites. The actual names of the statistics are given in the Statistic Name column, and their definitions are given in the Definition column. Each statistic in the table below has an associated standard error of estimate that will be provided in the StreamStats output, if it is available. Streamflow statistics are determined for data-collection stations from a limited sample of data; therefore, the statistics are not known with exact precision. The standard error of estimate, in percent, is an indication of the accuracy of the statistic. The actual values of the streamflow statistics will be within the given standard errors of estimate approximately two-thirds of the time.

Label	ID	Definition	English	Metric
APRD1	April_1_Percent_Duration	Streamflow exceeded 1 percent of the time	cubic feet per second	m3 per second
APRD10	April_10_Percent_Duration	April streamflow exceeded 10 percent of the time	cubic feet per second	m3 per second
APRD15	April_15_Percent_Duration	April streamflow exceeded 15 percent of the time	cubic feet per second	m3 per second
APRD2	April_2_Percent_Duration	April streamflow exceeded 2 percent of the time	cubic feet per second	m3 per second
APRD20	April_20_Percent_Duration	April streamflow exceeded 20 percent of the time	cubic feet per second	m3 per second
APRD25	April_25_Percent_Duration	April streamflow exceeded 25 percent of the time	cubic feet per second	m3 per second
APRD3	April_3_Percent_Duration	April streamflow exceeded 3 percent of the time	cubic feet per second	m3 per second
APRD30	April_30_Percent_Duration	April streamflow exceeded 30 percent of the time	cubic feet per second	m3 per second
APRD35	April_35_Percent_Duration	April streamflow exceeded 35 percent of the time	cubic feet per second	m3 per second
APRD40	April_40_Percent_Duration	April streamflow exceeded 40 percent of the time	cubic feet per second	m3 per second

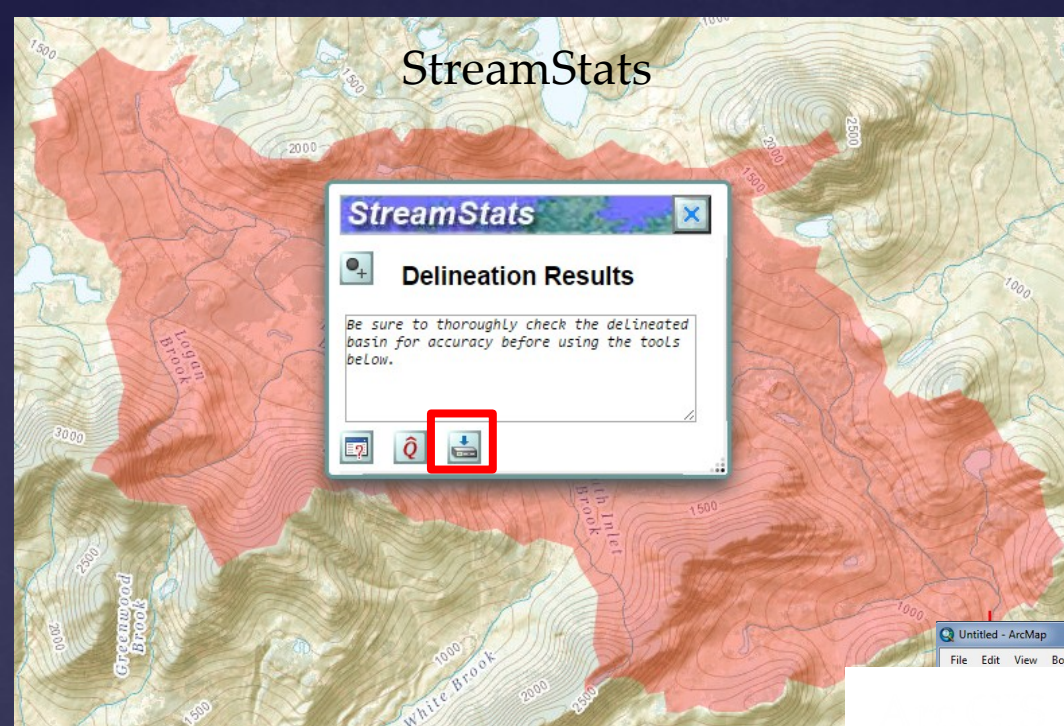
Editing a Basin Boundary

NOT YET AVAILABLE

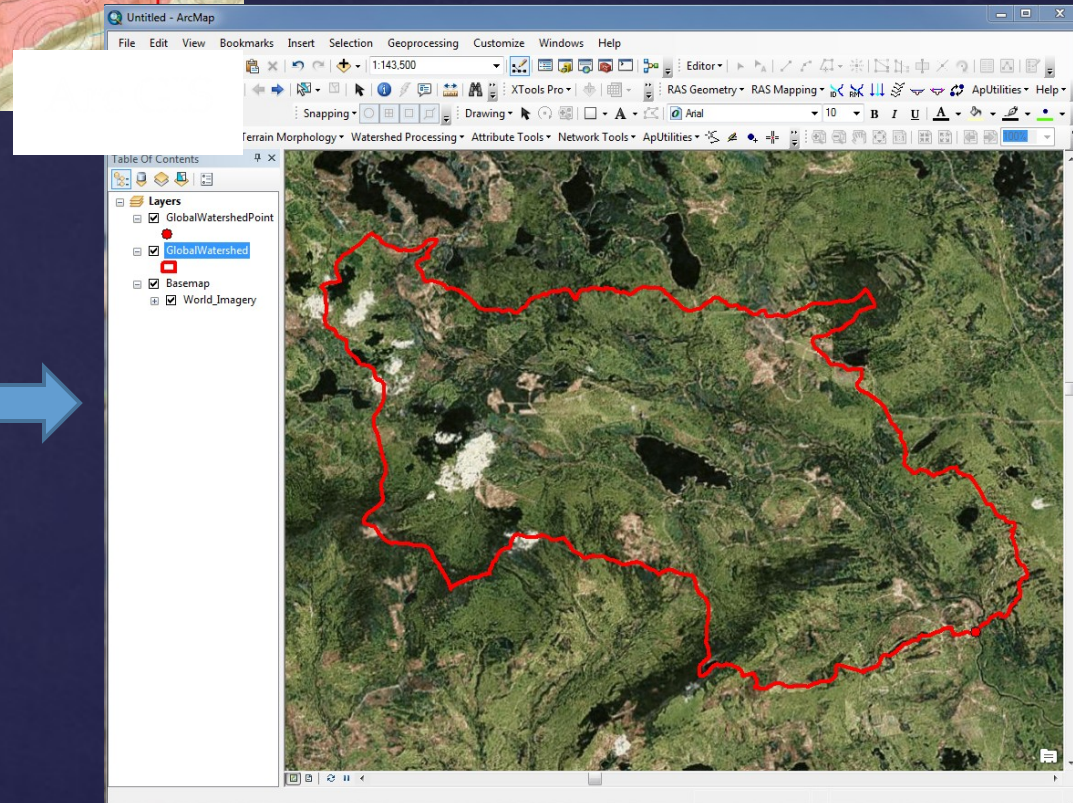


Download Basin Delineation

Arc GIS

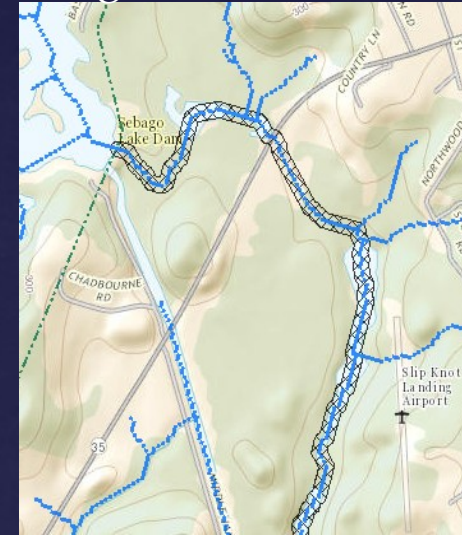


The image shows the "USGS StreamStats" download dialog box. It has a "Download" button at the top. Below it, there is a section titled "Choose output format" with two radio buttons: "Shapefile" (selected) and "File Geodatabase". At the bottom, there is another "Download" button.

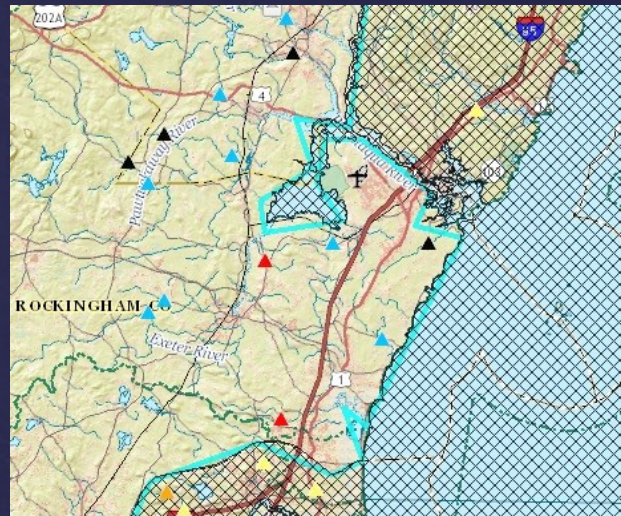


Areas of Limited Functionality

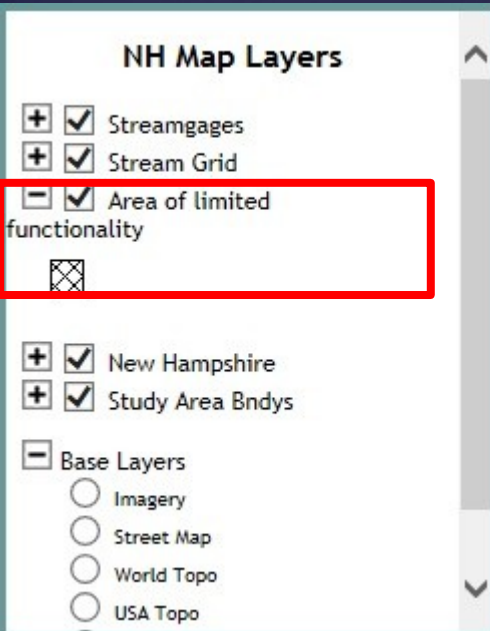
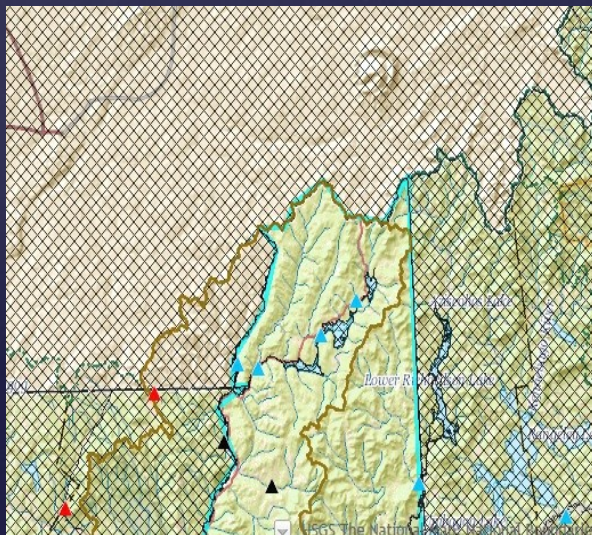
Regulated Streams



Coast



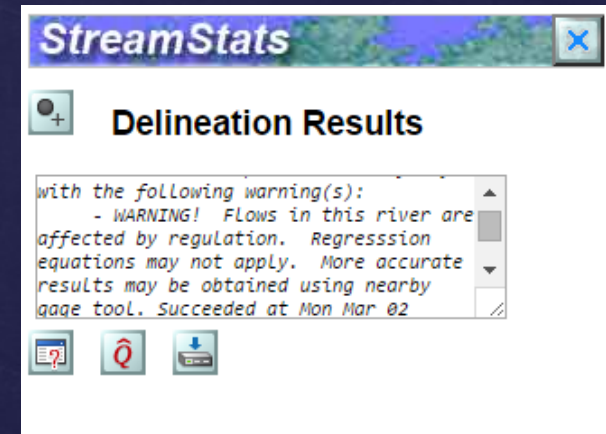
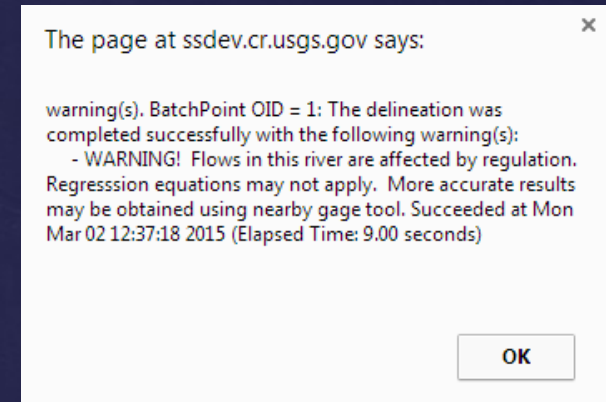
Canada, Maine and Vermont



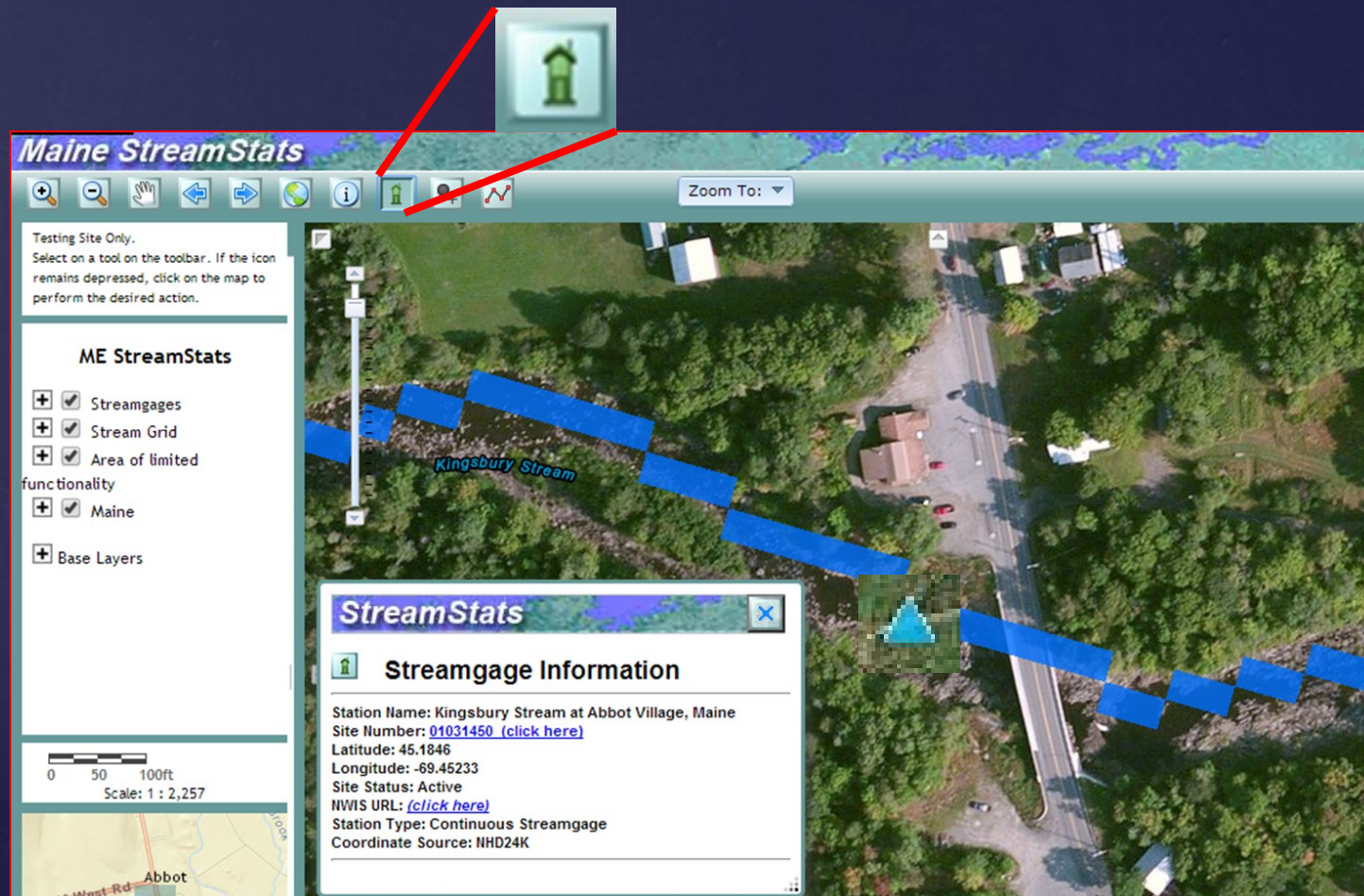
StreamStats

Warnings

- Warning Pop-ups
 - Point outside of NH boundary
 - Part of Basin outside of NH
 - Coastal/Tidal
 - Regulated Rivers
- Warnings Output
 - Outside range of explanatory variables



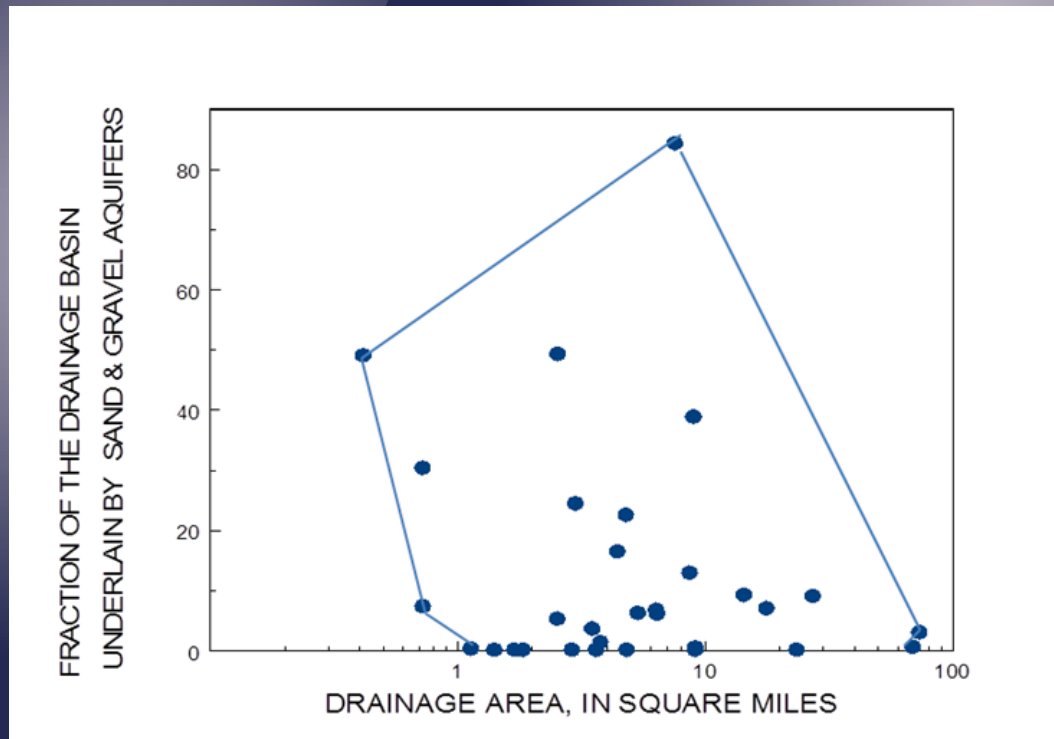
- Estimates at ungaged sites assume natural flow
- Regulated Rivers: Calculate flow statistics based on similar gaging stations **NOT YET AVAILABLE**



StreamStats Limitations

Range of Data

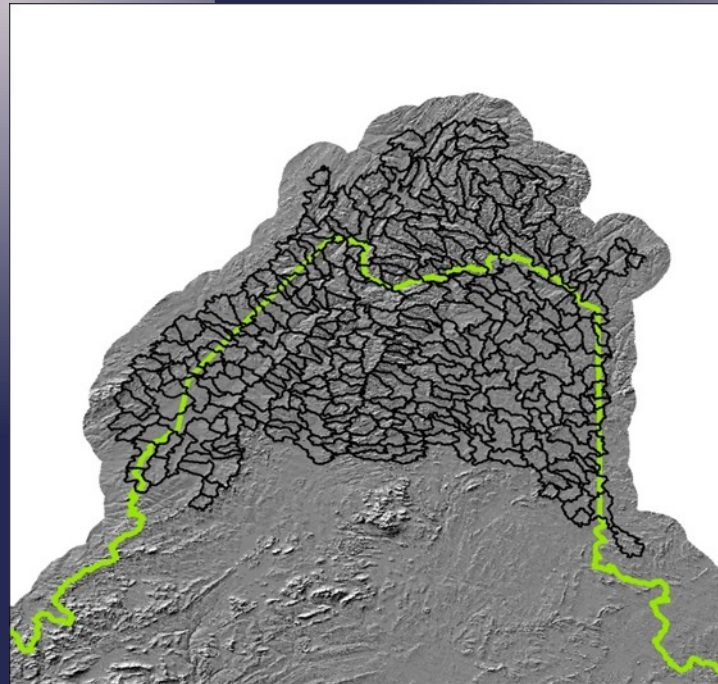
- Errors in estimates are unknown when basin characteristics are outside indicated ranges



StreamStats Limitations

Canadian Data

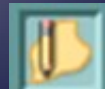
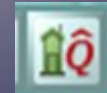
- Canadian Coverages are not equivalent to New England coverages
- Canadian regression equations are not equivalent to New England regression equations



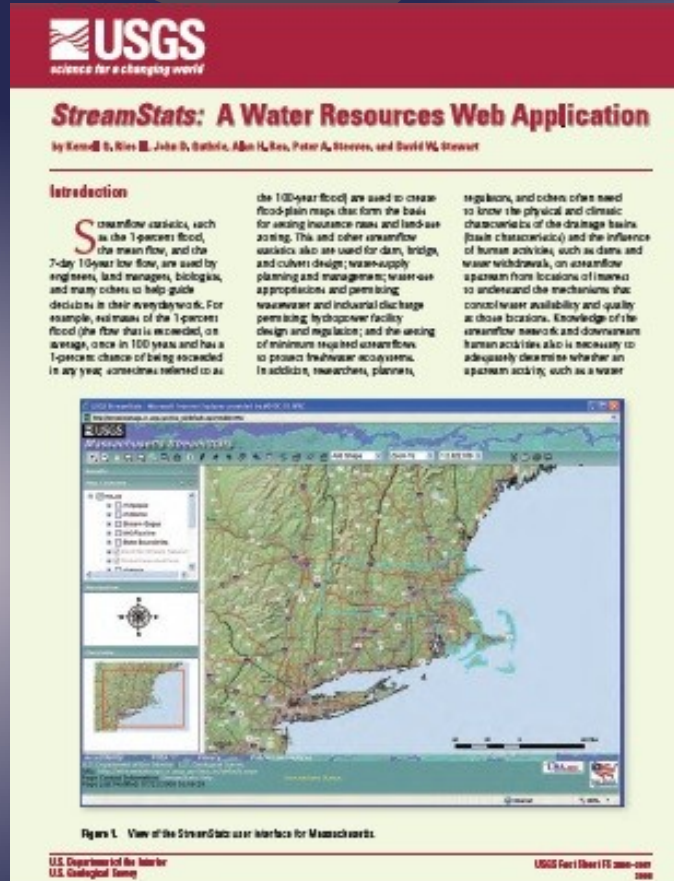
StreamStats National Transition

Single National User interface that accesses all state applications

- New options for zooming to sites of interest (e.g. to a streamgage)
- Not all functionality available in Version 4 yet
 - No estimates based on similar gages tool yet
 - No ability to edit a basin or basin parameters yet



StreamStats Fact Sheet



<https://pubs.usgs.gov/fs/2008/3067/pdf/fs-2008-3067-508.pdf>

StreamStats Computes Basin Characteristics



StreamStats Version 3.1

[Print](#)

Flow Statistics Ungaged Site Report

Date: Tues May 10, 2016 11:31:04 AM GMT-4

Study Area: New Hampshire

NAD 1983 Latitude: 43.1054 (43 06 19)

NAD 1983 Longitude: -71.6804 (-71 40 50)

Drainage Area: 45.4 mi²

Peak Flows Region Grid Basin Characteristics

100% Peak Flow Statewide SIR2008 5206 (45.4 mi²)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	45.4	0.7	1290
Mean April Precipitation (inches)	4.022	2.79	6.23
Percent Wetlands (dimensionless)	6.5665	0	21.8
Stream Slope 10 and 85 Method (feet per mi)	32.4	5.43	543

LowFlows Region Grid Basin Characteristics

100% Low Flow Statewide (45.4 mi²)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	45.4	3.26	689
Mean Basin Slope from 30m DEM (percent)	9.920	3.19	38.1
Maximum Basin Elevation (feet)	1523.316	260	6290
Percent Coniferous Forest (percent)	22.8068	3.07	56.2
Jan to Mar Basin Centroid Precip (inches)	8.23	5.79	15.1
Mean Annual Temperature (degrees F)	71.165 (above max value 48.7)	36	48.7
Jun to Oct Mean Basinwide Temp (degrees F)	60.831	52.9	64.4
Jun to Oct Gage Precipitation (inches)	16.7	16.5	23.1
Percent Mixed Forest (percent)	27.0175	6.21	46.1
Mar to May Gage Precipitation (inches)	8.4	6.83	11.5

Warning: Some parameters are outside the suggested range. Estimates will be extrapolations with unknown errors.

StreamStats Computes Flow Statistics

Peak Flows Region Grid Statistics						
Statistic	Value	Unit	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
					Min	Max
PK2	1140	ft3/s	30	3.2	708	1840
PK5	1790	ft3/s	31	4.7	1090	2920
PK10	2310	ft3/s	32	6.2	1390	3830
PK25	2970	ft3/s	34	8	1730	5100
PK50	3510	ft3/s	36	9	1990	6200
PK100	4160	ft3/s	39	9.8	2280	7580
PK500	5650	ft3/s	44	11	2870	11100

<http://pubs.usgs.gov/sir/2008/5206/>

Olson, S.A., 2009, Estimation of flood discharges at selected recurrence intervals for streams in New Hampshire: U.S. Geological Survey Scientific Investigations Report 2008-5206, 57 p.

Statistic	Value	Unit
D60WIN	0.43	dim
D70WIN	0.36	dim
D80WIN	0.32	ft3/s
D90WIN	0.24	dim
D95WIN	0.19	dim
D98WIN	0.17	dim
M7D2Y WIN	0.33	ft3/s
M7D10Y WIN	0.18	ft3/s
D60SPR	2.31	dim
D70SPR	1.76	dim
D80SPR	1.32	dim
D90SPR	0.89	dim
D95SPR	0.63	dim
D98SPR	0.47	dim
M7D2Y SPR	0.55	ft3/s
M7D10Y SPR	0.3	ft3/s
D60SUM	0.83	dim
D70SUM	0.66	dim
D80SUM	0.58	dim
D90SUM	0.41	dim
D95SUM	0.33	dim
D98SUM	0.25	dim
M7D2Y SUM	0.43	ft3/s
M7D10Y SUM	0.24	ft3/s
D60FALL	0.99	dim
D70FALL	0.78	dim
D80FALL	0.63	dim
D90FALL	0.43	dim
D95FALL	0.28	dim
D98FALL	0.18	dim
M7D2Y FAL	0.6	ft3/s
M7D10Y FAL	0.29	ft3/s
D60	1.11	ft3/s
D70	1.92	ft3/s
D80	3.3	ft3/s
D90	6.85	ft3/s
D95	11	ft3/s
D98	15.1	ft3/s
M7D2Y	9.63	ft3/s
M7D10Y	15	ft3/s

And... in NH: GW Recharge Rate Statistics and Basin Characteristics

Groundwater Recharge Region Grid Basin Characteristics			
100% Groundwater Recharge Statewide 2004 5019 (0.84 mi ²)			
Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	0.84 (below min value 3.26)	3.26	689
Mean Annual Precip at Gage (inches)	55.8 (above max value 53.11)	35.83	53.11
Jun to Oct Gage Precipitation (inches)	27.3 (above max value 23.11)	16.46	23.11
Mar to May Gage Precipitation (inches)	10.4	6.83	11.54
Mean Annual Precip at Basin Centroid (inches)	56	37.44	75.91
Mean Annual Temperature (degrees F)	21.000 (below min value 36.05)	36.05	48.69
Mean Winter Min Temperature (degrees F)	1.873	0.8	19.88
Percent Coniferous Forest (percent)	41.3548	3.07	56.18
Percent Mixed Forest (percent)	20.0093	6.21	46.13
Nov to Dec Basin Centroid Precip (inches)	9.76	6.57	15.2
Mean Annual Snowfall (inches)	202.118	54.46	219.07

Warning: Some parameters are outside the suggested range. Estimates will be extrapolations with unknown errors.

Statistic	Value	Unit
RCHRG WIN	4.06	in
RCHRG SPR	13.7	in
RCHRG SUM	13.9	in
RCHRG FAL	3.23	in
RCHRG ANN	23.8	in

Questions